Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2016–2017

Science: Single Award

Unit 2 (Chemistry)

Higher Tier

[GSS22]

GSS22

THURSDAY 18 MAY 2017, MORNING

TIME

1 hour 15 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete in black ink only. **Do not write with a gel pen.**
Answer **all twelve** questions.

INFORMATION FOR CANDIDATES

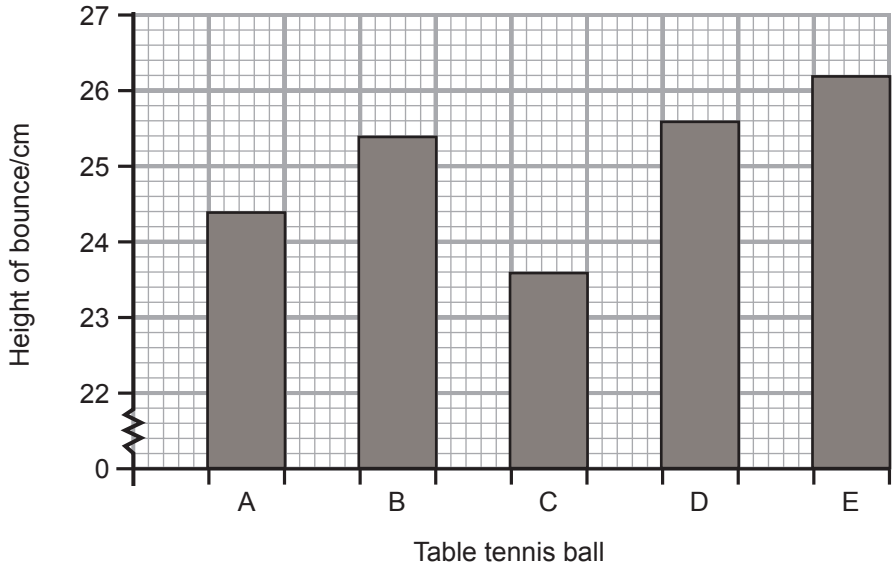
The total mark for this paper is 75.
Quality of written communication will be assessed in Questions **4** and **11**.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

11312

1 Before being used table tennis balls must first pass a test to make sure they bounce to the correct height.

Each ball was dropped once from a height of 30 cm onto a steel block. The ball should bounce more than 24 cm but less than 26 cm.

(a) The results for five table tennis balls are given below.



(i) Which table tennis balls (**A**, **B**, **C**, **D** or **E**) have failed the test?

_____ and _____ [1]

(ii) Suggest **one** way in which the reliability of the results could have been improved.

_____ [1]

(iii) Table tennis balls are made from a type of polymer. Describe fully the process of polymerisation.

_____

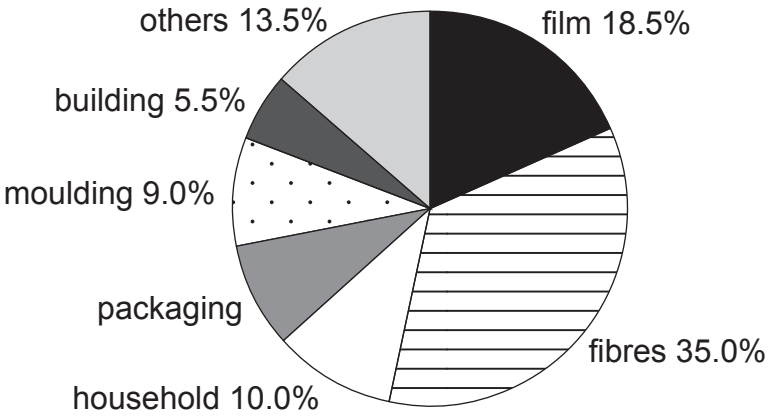
_____

_____ [2]

(b) Polypropene is a plastic that has many uses.

It breaks easily at temperatures below 5 °C but gets more flexible as it warms up. It melts around 130 °C.

The pie chart below shows the uses of polypropene.



(i) Calculate the percentage of polypropene that is used in packaging.

(Show your working out.)

_____ % [2]

(ii) Suggest why packaging made from polypropene is not used in cold conditions where the temperature can drop as low as 0 °C.

_____

_____ [1]

[Turn over

2 Given below is information about some materials.

Material	Cost per tonne/£	Melting point/°C	Resistance to water damage	Density/ g/cm^3	Electrical conductivity
Aluminium	785	660	High	2.7	Very good
Steel	75	1535	Low	7.8	Average
Stainless steel	650	1480	High	7.9	Average
Copper	3238	1083	High	8.9	Excellent
PVC plastic	230	160	High	1.4	None
Iron	40	1528	Low	7.9	Average

Use this information to answer the following questions.

(a) PVC plastic is used to make children's buckets and spades.
Give **one** reason why PVC plastic is chosen.

_____ [1]

Mountain hikers often carry hiking poles when walking long distances in wet and cold conditions. They use these to help them avoid injury on uneven mountain paths.

© lzf / iStock / Thinkstock

(b) Name the metal from the table which would be most suitable for making hiking poles. Give **two** reasons explaining your choice for each.

_____

_____

_____

_____

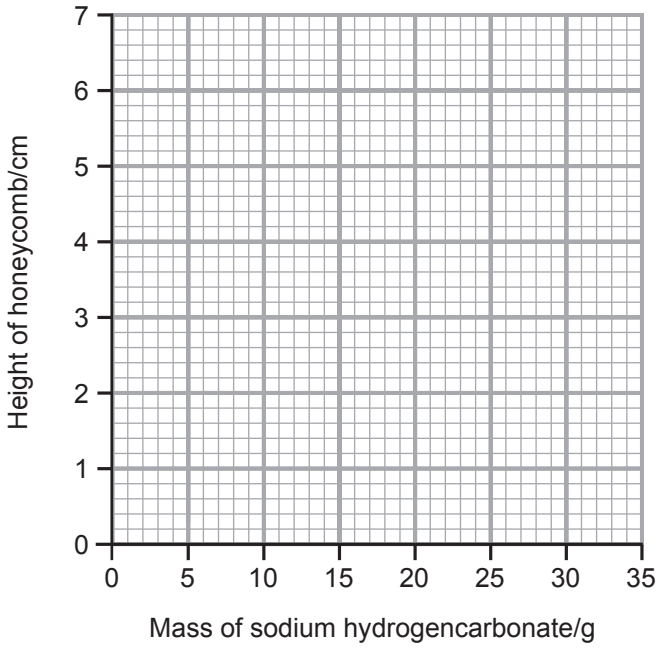
_____ [3]

[Turn over

3 Mary and Jack were making honeycomb. They found that changing the amount of sodium hydrogencarbonate added changed the height by which the honeycomb rose. The results are shown in the table below.

Mass of sodium hydrogencarbonate/g	0	5	10	15	20	25	30	35
Height of honeycomb/cm	0	2.5	4.2	5.2	5.7	6.0	6.0	6.0

(a) (i) Plot a **line graph** of these results on the grid below.



[3]

(ii) What was the height of the honeycomb when 12 g of sodium hydrogencarbonate was added?

_____ cm [1]

(b) (i) Describe fully the trend shown by these results.

_____

_____

_____

_____ [2]

(ii) A company wants to make honeycomb in 6 cm pieces to sell and make the maximum amount of money. Explain fully why it should use 25 g of sodium hydrogencarbonate.

_____

_____

_____

_____ [2]

(c) Mary suggested that a few drops of citric acid added to the mixture would have given an even greater height.

Complete the word equation for this reaction.

sodium hydrogencarbonate	+	citric acid	→		+		+	

[2]

[Turn over

4 A forensic scientist wanted to know if the paint from a car involved in a hit and run accident contained calcium ions or lead ions. He decided to carry out a flame test on the paint.

Describe how the forensic scientist would carry out a flame test on the paint.

Your answer should include:
- how the test is carried out on the paint
- the results expected for calcium ions and lead ions.

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

[6]

5 Thermochromic and photochromic paints are smart materials which alter with a change in the surrounding environmental conditions.

(a) Give the environmental condition that causes photochromic paint to change.

_____ [1]

Shown below is a baby's feeding spoon.

© David Arky / Mint Images / Science Photo Library

(b) The spoon is made from thermochromic plastic which changes colour at temperatures over 43 °C.

Suggest how this may make the spoon safer to use.

_____

_____

_____ [2]

(c) Recent research in nanotechnology has found that nanosized particles of silver are useful in sterilising sprays.
Explain fully what is meant by the term 'nanotechnology'.

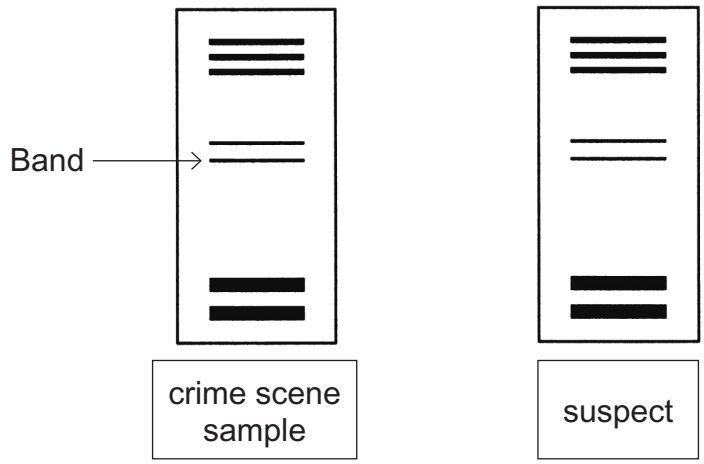
_____

_____

_____ [2]

[Turn over

6 Below are the genetic fingerprints taken from a crime scene and from a suspect.



(a) What do the bands in a genetic fingerprint contain?

_____ [1]

(b) Explain why the police are certain that the suspect produced the crime scene sample and it could not have been anyone else.

_____

_____

_____

_____ [2]

(c) Many people have campaigned for a national database of everyone's fingerprints.
Give **one** argument for and **one** argument against such a database.

For _____

_____

Against _____

_____ [2]

(d) Apart from blood and hair, suggest **one** substance from the body that could be used to produce a genetic fingerprint.

_____ [1]

[Turn over

7 **(a)** The following diagrams represent the arrangement of molecules in two substances.

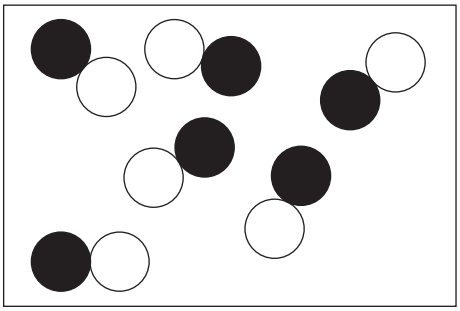


Diagram A

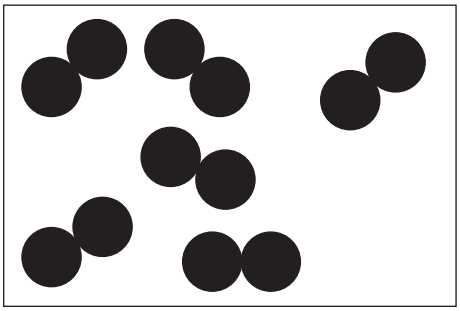


Diagram B

(i) The molecules in diagram **A** represent a compound.
Explain what is meant by the term 'compound'.

_____

_____

_____ [2]

(ii) Name a substance that could be represented by diagram **B**.

_____ [1]

(b) The formula for methanol is CH_3OH.

(i) How many different elements are present in methanol?

_____ [1]

(ii) How many atoms are represented by this formula?

_____ [1]

8 The table below gives information about five atoms, **A**, **B**, **C**, **D** and **E**.

Atom	Number of protons	Number of electrons	Number of neutrons
A	11	11	12
B	12	12	12
C	10	10	10
D	20	20	20
E	17	17	20

You may find your Data Leaflet helpful.

(a) Calculate the mass number for atom **E**. _____ [1]

(b) In which Group of the Periodic Table would you find atom **A**? _____ [1]

(c) Which atom (**A**, **B**, **C**, **D**, or **E**) is a noble gas? _____ [1]

(d) Which atom (**A**, **B**, **C**, **D**, or **E**) is found in Period 2 of the Periodic Table? _____ [1]

[Turn over

9 A student investigated the hardness of four different samples of water.

The results are shown below.

Sample	Volume of soap solution required to form a lather before boiling/cm^3	Volume of soap solution required to form a lather after boiling/cm^3
W	24	24
X	26	2
Y	18	13
Z	21	11

(a) From the results which sample (**W**, **X**, **Y** or **Z**) has:

(i) the hardest water? _____ [1]

(ii) the greatest problem with kettle 'fur'? _____ [1]

(b) What can the student conclude about sample **W**?
Explain your answer.

_____

_____

_____

_____ [3]

(c) Hardness in water may be caused by calcium hydrogencarbonate.
Complete the word equation to show how this hardness is removed by boiling.

calcium hydrogencarbonate	→	water	+		+	

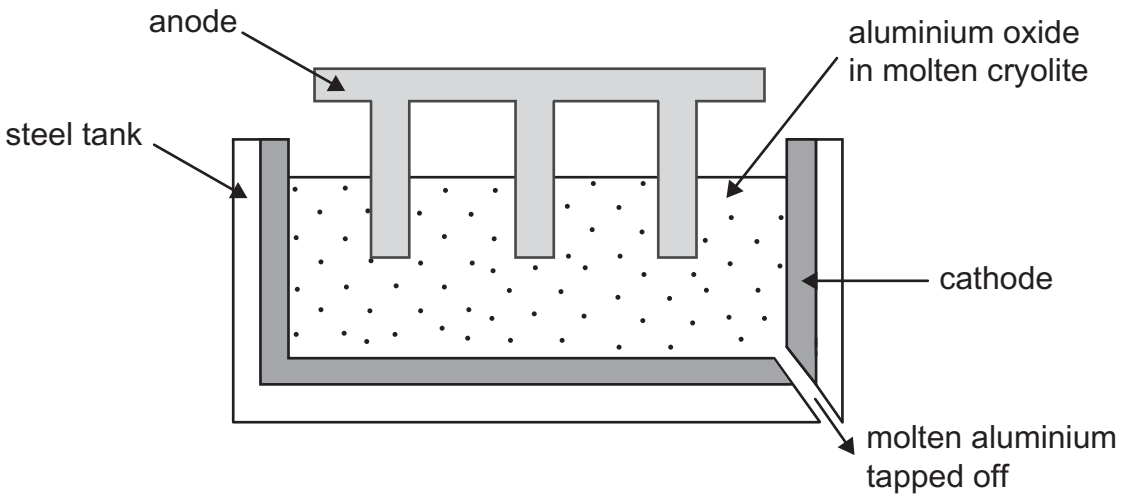
[2]

(d) Name a tourist attraction found in a hard water area.

_____ [1]

[Turn over

10 **(a)** Aluminium is a metallic element that is extracted from its ore by electrolysis.



(i) Explain what is meant by the term 'electrolysis'.

_____

_____

_____ [2]

(ii) Name the gas produced at the anode.

_____ [1]

(b) Information about two metals is given in the table below.

Metal	Colour of solid metal	Colour of sulfate solution
zinc	grey	colourless
copper	pink/brown	blue

Use this information to complete the sentences below about displacement reactions.

(i) In the reaction of zinc with copper sulfate solution the colour of the **solution**

changes from _____ to _____. [1]

(ii) In the reaction of zinc with copper sulfate the colour of the **solid metal**

changes from _____ to _____. [1]

(c) Sodium reacts with chlorine to form the compound sodium chloride.
Describe in terms of electrons, how the bond in sodium chloride is formed.

_____

_____

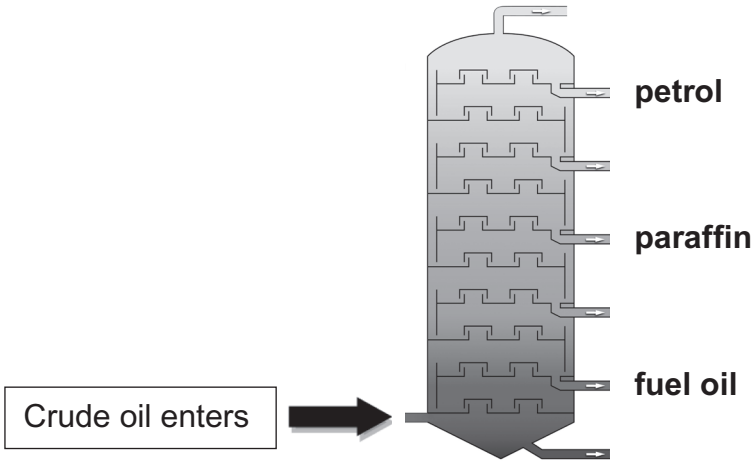
_____

_____

_____ [3]

[Turn over

11 Crude oil is made up of many hydrocarbons and can be separated into different fractions, some of which are shown in the diagram below.



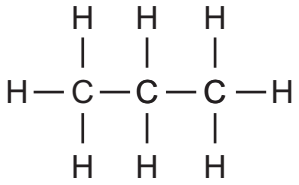
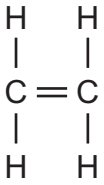
© Science Photo Library

Name and describe this process. Your answer should include an explanation of what a hydrocarbon is and the names of two of the remaining fractions produced.

In this question, you will be assessed on your written communication skills including the use of specialist scientific terms.

[6]

12 **(a)** Complete the table below about some hydrocarbons.

Name of hydrocarbon	Molecular formula	Structural formula
	C_3H_8	
ethene		
butane	C_4H_{10}	

[3]

(b) Complete the balanced symbol equation for the complete combustion of methane in air.

CH_4 + → +

[3]

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For Examiner's use only	
Question Number	Marks
1	
2	
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8	
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10	
11	
12	
Total Marks	

Examiner Number

SYMBOLS OF SELECTED IONS

Positive ions

Name	Symbol
Ammonium	NH_4^+
Chromium(III)	Cr^{3+}
Copper(II)	Cu^{2+}
Iron(II)	Fe^{2+}
Iron(III)	Fe^{3+}
Lead(II)	Pb^{2+}
Silver	Ag^+
Zinc	Zn^{2+}

Negative ions

Name	Symbol
Carbonate	CO_3^{2-}
Dichromate	$Cr_2O_7^{2-}$
Ethanoate	CH_3COO^-
Hydrogen carbonate	HCO_3^-
Hydroxide	OH^-
Methanoate	$HCOO^-$
Nitrate	NO_3^-
Sulfate	SO_4^{2-}
Sulfite	SO_3^{2-}

SOLUBILITY IN COLD WATER OF COMMON SALTS, HYDROXIDES AND OXIDES

Soluble
All sodium, potassium and ammonium salts
All nitrates
Most chlorides, bromides and iodides EXCEPT silver and lead chlorides, bromides and iodides
Most sulfates EXCEPT lead and barium sulfates Calcium sulfate is slightly soluble

Insoluble
Most carbonates EXCEPT sodium, potassium and ammonium carbonates
Most hydroxides EXCEPT sodium, potassium and ammonium hydroxides
Most oxides EXCEPT sodium, potassium and calcium oxides which react with water

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DATA LEAFLET

For the use of candidates taking
Science: Chemistry,
Science: Double Award
or Science: Single Award

Copies must be free from notes or additions of any kind. No other type of data booklet or information sheet is authorised for use in the examinations.

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THE PERIODIC TABLE OF ELEMENTS

Group

1	2											3	4	5	6	7	0
							1 H Hydrogen 1										4 He Helium 2
7 Li Lithium 3	9 Be Beryllium 4											11 B Boron 5	12 C Carbon 6	14 N Nitrogen 7	16 O Oxygen 8	19 F Fluorine 9	20 Ne Neon 10
23 Na Sodium 11	24 Mg Magnesium 12											27 Al Aluminium 13	28 Si Silicon 14	31 P Phosphorus 15	32 S Sulfur 16	35.5 Cl Chlorine 17	40 Ar Argon 18
39 K Potassium 19	40 Ca Calcium 20	45 Sc Scandium 21	48 Ti Titanium 22	51 V Vanadium 23	52 Cr Chromium 24	55 Mn Manganese 25	56 Fe Iron 26	59 Co Cobalt 27	59 Ni Nickel 28	64 Cu Copper 29	65 Zn Zinc 30	70 Ga Gallium 31	73 Ge Germanium 32	75 As Arsenic 33	79 Se Selenium 34	80 Br Bromine 35	84 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	89 Y Yttrium 39	91 Zr Zirconium 40	93 Nb Niobium 41	96 Mo Molybdenum 42	99 Tc Technetium 43	101 Ru Ruthenium 44	103 Rh Rhodium 45	106 Pd Palladium 46	108 Ag Silver 47	112 Cd Cadmium 48	115 In Indium 49	119 Sn Tin 50	122 Sb Antimony 51	128 Te Tellurium 52	127 I Iodine 53	131 Xe Xenon 54
133 Cs Caesium 55	137 Ba Barium 56	139 La* Lanthanum 57	178 Hf Hafnium 72	181 Ta Tantalum 73	184 W Tungsten 74	186 Re Rhenium 75	190 Os Osmium 76	192 Ir Iridium 77	195 Pt Platinum 78	197 Au Gold 79	201 Hg Mercury 80	204 Tl Thallium 81	207 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	210 At Astatine 85	222 Rn Radon 86
223 Fr Francium 87	226 Ra Radium 88	227 Ac† Actinium 89	261 Rf Rutherfordium 104	262 Db Dubnium 105	263 Sg Seaborgium 106	262 Bh Bohrium 107	265 Hs Hassium 108	266 Mt Meitnerium 109	269 Ds Darmstadtium 110	272 Rg Roentgenium 111	285 Cn Copernicium 112						

140 Ce Cerium 58	141 Pr Praseodymium 59	144 Nd Neodymium 60	147 Pm Promethium 61	150 Sm Samarium 62	152 Eu Europium 63	157 Gd Gadolinium 64	159 Tb Terbium 65	162 Dy Dysprosium 66	165 Ho Holmium 67	167 Er Erbium 68	169 Tm Thulium 69	173 Yb Ytterbium 70	175 Lu Lutetium 71
232 Th Thorium 90	231 Pa Protactinium 91	238 U Uranium 92	237 Np Neptunium 93	242 Pu Plutonium 94	243 Am Americium 95	247 Cm Curium 96	245 Bk Berkelium 97	251 Cf Californium 98	254 Es Einsteinium 99	253 Fm Fermium 100	256 Md Mendelevium 101	254 No Nobelium 102	257 Lr Lawrencium 103

* 58 – 71 Lanthanum series
† 90 – 103 Actinium series

a / b x
a = relative atomic mass (approx)
x = atomic symbol
b = atomic number